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ABSTRACT

This paper addresses criteria in the design and development of computer-based courseware. The term "interactive multimedia" describes both the technology and the demands placed on the user. It implies that the user becomes actively engaged with the subject, thereby improving the likelihood that net learning takes place. However, nothing is implied about the educational process(es) involved, or the contextual factors that could enhance educational outcome. A selection of types of Computer-Aided Learning are briefly described: tutorial, drill and practice, integrated performance support systems, simulations, interactive exploration, data bank, attention grabbers, new ways of showing data, interactive hypertext book, expert systems and artificial intelligence, computer adaptive testing, and computer managed learning. The paper looks at quality in interactive multimedia, and the larger question of the definition of quality in university teaching and learning. Refinement of ideas and goals regarding quality in learning will go a long way toward clarifying how educators might best employ the technological tools available to them. The new age economics encourages educators to think of students as the universities' customers--customer satisfaction is thus defined in terms of the extent to which educators can meet learning requirements. As insights into the educational process in an information rich environment grow, educators will be able to fashion their digital course resources into the most appropriate courseware design that fits within the myriad of constraints under which each educator operates. (Contains 14 references.) (SWC)

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Interactive Multimedia in University Teaching and Learning: Some Pointers to Help Promote Discussion of Design Criteria

By:

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Preamble

This paper has its origins in a personal position paper on interactive multimedia that I was encouraged to draft in 1994, at a time when debate on quality in Australian tertiary education was flourishing. In the event it was not used for the original purpose and what follows is an abbreviated version directed at starting discussion on criteria in the design and development of computer-based courseware. A list of questions to help initiate discussion are in the appendix.

It is important to note that the content does not purport to be comprehensive, definitive or even necessarily representative. It is merely a personal perspective that draws on two useful overviews by other authors informed by my own experience. Details of some of my own work in computer-assisted learning are in Trevitt et al. (1993), Trevitt (1994), Trevitt and Sachse-Akerlind (1994), and Trevitt et al. (1994). An overview is also available via the world wide web at: http://www.anu.edu.au/Forestry/fire/ACFT/acft.html.

Introduction

One way we can start is by asking 'What is interactive multimedia?' and 'What is university teaching and learning ?'. Nowadays (at least in Australia) we would ask, correctly, 'What is quality in university teaching and learning ?' Therefore, presumably, we would be well advised, first, to ask 'What is quality in interactive multimedia ?' Don't expect a definitive answer in what follows, but I'll pursue these questions a little further in an attempt to start some discussion.

Before doing this however, one idea that might be worth bearing in mind comes from a recent suggestion by Wilson (1994). He suggests that human attention not information per se will be the real currency as we move into the so-called information age. This is an intriguing suggestion that bears closer consideration from the point of view of the changing nature of teacher/student relations. Many of us in the 'teaching' game acknowledge that we are already awash with information and some of us are constantly seeking more efficient and effective ways to distinguish data, information and knowledge (eg Brack and Trevitt, 1995). What are we doing to foster such skill development by our students ? or even to encourage our students to approach their studies from this point of view ? Is there even merit in doing this ? I believe these are

important questions that form a useful backdrop to any discussion of design criteria in the development of computer-based learning materials.

What is interactive multimedia ?

The phrase 'interactive multimedia' tells you something about both the technology and the demands placed on the user. These two threads bear closer examination and clarification. Firstly, the technological concept represented by the term multimedia is really a misnomer, it is actually unimedia - information is being stored and communicated in a digital form no matter whether it is text, images, sound, etc rather than in a variety of analogue formats (eg books, photographs, cassette tape, film, etc).

Secondly, the implication is that because the user must interact with the technology, then he or she stands a better chance of becoming actively engaged with the subject, thereby improving the liklihood that net learning takes place. In fact nothing is implied about the educational process(es) involved, or the contextual factors that could or should be employed to enhance educational outcomes. Apparently, the computer is the context, and that is enough.

It is my opinion that this may well be the case while novelty and hype still abound. However, when finally the dust begins to settle and level-headed assessors want to know what the score is, it will be those developments which have searched successfully beyond this simple model that survive. The important question, therefore, is 'What constitutes success on these terms ?'

Some categories of Computer-Aided Learning

One starting point for a discussion along these lines is the following list of different types of Computer-Aided Learning (CAL). This list is taken from a presentation by Bell (1993), but where relevant I have given examples and references from my own work. It is by no means exhaustive, there are bound to be other, additional examples (eg email and/or internet facilitated discussion - see Green et al., 1993; Trevitt et al, 1994). Each approach meets different needs and requires different amounts of development time. No one approach will be right in all circumstances. The choice is up to you, the designer, and/or you, the user.

Tutorial.

Traditionally, CAL has been seen as providing a (more flexible) tutorial with no or little instructor intervention. Although these stand alone packages are time consuming to produce, once prepared, they enable many users to work through them at their own pace and, if well designed, to an individually appropriate depth.

Drill and practice.

Computerised modules are particularly good at delivering large quantities of drill and practice work because students have access to as many examples as they need and can work at their own pace and gain immediate feedback. As with children's arcade games, drill and practice sessions work best if they incorporate a challenge, an element of chance and immediate feedback. They also require a means of progression in the event that students become stuck.

Integrated Performance Support Systems.

Often training can be summed up by "too much too soon, too little too late." We tend to try to teach students everything they might ever need to know when they first embark on a career and then too often provide little or no on-going training. An alternative approach is to provide extensive contextual-support for operational professionals. In many cases they may not even be aware that they are being trained. Work on this concept is underway in the meteorology profession, both nationally (in Australia) and internationally (Bell, 1994, pers comm).

Simulations.

These can vary from simple simulations of natural processes or physical phenomena to more complex management scenarios. In the latter case resources (eg text, imagery and sound) may be accessed via computer to provide context for decision-making situations. (See also Data Bank, below.) Examples include the laser disc fire control simulator (Thorburn, 1990) and the work I am involved in at ANU (eg Trevitt and Sachse-Akerlind, 1994).

Interactive exploration.

Students now have the opportunity to use computers to interactively explore data, processes or tools. An example here is the work in fire weather visualisation that we have undertaken at ANU (Trevitt et al., 1993).

Data Bank.

If a data bank, or resource bank, is built up, either on hard disk, CD-ROM, interactive video disc or on a server, students may access it for projects. The data may, for example, include animated, annotated and interactive images. A good example here is the ANU Artserver developed by Prof M. Greenhalgh which operates via the World Wide Web (http://rubens.anu.edu.au/) and provides access to many thousands of images in Art History.

Attention grabbers.

As an aid to presentation drawings, clip art, photographs, animations, etc., may be shown to set a context and grab the audience's attention. This is what most teachers already do when they employ slides or videos to illustrate their arguments.

New ways of showing data.

For training and education purposes, we may wish to show data in ways that wouldn't normally be used operationally. This helps expose the steps involved in analysis or planning, and the challenge of integrating data and applying it to a specific context.

Interactive Hypertext Book.

This can loosely be thought of as a computer-based text book. It should not attempt to do all the things that current text books do but, instead, concentrate on the things that computer-aided presentations are good at. This would include coloured annotated graphics which could be built up or interacted with, animations, hot words linking to other sections, video, access to data banks, links to tutorials, etc. I believe this concept holds considerable promise for imaginative access to a diverse and ultimately comprehensive range of resources to support curriculum delivery in rural fire science and management. This is a concept that I am actively trying to implement, and explore further (eg Trevitt et al., 1994).

Expert systems and artificial intelligence.

Expert systems could be used to distill the thought processes, hunches, rules-of-thumb, etc. of someone well versed in an activity, for example, a seasoned rural fire control boss. This is one area that has already enjoyed considerable investment of time and effort and, so far, at least where rural fire management is concerned, I think it is fair to say has paid few dividends (see, for example, discussion by Moore and Trevitt, 1991).

Computer adaptive testing.

This can be used to intelligently test students. New questions are presented at higher or lower levels depending on previous answers so that assessment will be individually and dynamically tailored to student learning.

Computer managed learning.

These systems allow both the trainer and the students to keep track of the students' progress.

What is Quality in interactive multimedia ?

In this section we need to go one step further and see if there may be certain situations in which one design and instructional technique may be more appropriate than another. Here, I will draw on the work by Montgomery Woods et al., (1993). These authors assessed the variety of design and instructional techniques used in 22 commercially available CD-rom packages, embracing educational, books, children's stories and games. Their intention was to examine a broad cross section of material outside of academia in order to identify effective devices, useful for the design of more effective courseware.

Three types of education courses, oriented according to process, subject or ideas, were identified by these workers. Process oriented courses are concerned with a specific sequence of steps (eg fire management planning); subject oriented courses focus on interconnectedness as perceived by experts in the field (eg art history); ideas oriented courses may be problem-based, with students being encouraged to develop their own ideas for problem resolution or situation improvement (see Trevitt and Sachse-Akerlind, 1994).

Montgomery Woods and co-workers identified four characteristics which appeared to contribute to the success of a courseware package. These are:

- **engagement** - the ability to captivate and retain learner interest
- **access** - the ability to provide ready and simple access to information
- **clarification** - the ability to provide alternative explanations or examples
- **practice** - the ability to provide practical opportunities for skill development

They then proposed a relationship between course type and three basic elements of courseware design: information structure, interactivity and interface design.

Information structure may be linear (sequential), branching (dendritic or hierarchical), matrixed (organised according to two separate criteria) or webbed (free flowing, complex pathways). (It has been suggested that webbed structures are likely to be confusing for novices, but I know of no evidence to support this claim, and my own experience suggests that undergraduates have few problems with such structures).

Interactivity was proposed to comprise four basic groups that they called: activation (simple), navigation, problem solving (distinguished from navigation on account of negative or positive consequences being associated with the result of the choice) and authorship (where users can make their own marginal or diary notes).

Interface design refers to the way the user operates the software. It includes issues relating to screen layout

and the manner in which the user is guided through the content. These impinge on the extent to which the user is engaged by the program.

Course type:	PROCESS	SUBJECT	IDEA
Information Organisation	Linear	Branching/Hierarchial Matrixed	Webbed
Interactivity	Activation Problem Solving	Activation Navigation Problem Solving	Activation Navigation Authorship
Engagement	Suspension of Disbelief Transparency Media Richness and Realism	Clarity Information Organisation Provides Clarity and Context	Challenge Creation Discussion
Access	Pace Appropriate Detail	Maneuverability Retracing steps Reinitiating search	Freedom Create Paths Alter Links
Clarification	Extraneous Loops	Refinement Relationships Alternate Perspectives	Mediated Electronic Discussion
Practice	Repetition Implementation Simulation	Completion Question/Answer	Extrapolation Creation of Text/Media

Table 1. Elements of successful courseware design identified according to course-type by Montgomery Woods et al. (1993).

Table 1 indicates the different ways in which all these factors were found to vary by course type. Further discussion of the issues raised by this table may be worth pursuing. Irrespective of all these criteria, Montgomery Woods et al. suggest that students' motivation is enhanced when they are provided with:

- a statement of objectives
- an overview of expected commitment
- a map of content organisation

In conclusion, they suggest that the concept of self-contained courseware packages shifts the onus of learning more firmly onto the student. As a result, the focus of design must be on the needs of the student. This is tantamount to subscribing to the constructionist theory of learning (eg Perry, 1970; Yager, 1991) whereby each individual student develops their own personal meaning which is a function of both past personal experiences and interaction with new ideas and other peoples' constructions (see also Trevitt and Sachse-Akerlind, 1994).

This is not to say that the role of the teacher is now redundant. Far from it, there remains as strongly as ever a demand for a human guide, facilitator and moderator of the learning process, as well as source of additional information and perhaps experiential insight. However, it does lead us logically into the final theme of this paper.

What is Quality in university teaching and learning ?

This is a much bigger question, of course, and one that is now flexing the minds of many in university administrations and the tertiary education bureaucracy, at least in Australia. Presumably this will continue to be the case while quality funds continue to be made available and ensure that quality in learning and teaching needs to be identified and distinguished from other sorts of teaching and learning. Perhaps the most important point in our context is to distinguish between state-of-the-art approaches to integrating information technology into learning and teaching, and state-of-the-art technology per se. The wide range of educational methodology and philosophy that can be accomodated and facilitated as a result of the recent convergence of information and communication technologies technologies means that those of us who are familiar and work with these tools would be wise to become at least as familiar with the educational rationale that helps determine how best to employ them. Anyone wishing to pursue further this line of thought is encouraged to start by reading 'Rethinking University Teaching - A framework for the effective use of educational technology' by Laurillard (1993).

It would be a mistake for me to imply here that I can offer more than a few passing observations on these bigger questions. I am just one player who happens to be working on the inside in the university sector. Nevertheless, given the suite of technologically assisted learning and teaching options itemised by Bell (1993) and the educational design matrix (Table 1) posed by Montgomery Woods et al. (1993), it should be obvious that some clear thinking is required to determine what constitutes an optimal solution in any given circumstances. At the very least, circumstances will vary from institution to institution, according to human factors such as departmental climate, student and/or course goals, student catchment, discipline focus, professional orientation, likely student employment destination, etc.

In closing, I suggest that refinement of our ideas and goals regarding quality in learning will go a long way towards clarifying how we might best employ the technological tools at our disposal to attain those goals. The new age economics encourages us to think in terms of students as the universities' customers. Customer satisfaction is thus defined in terms of the extent to which we can meet learning requirements. If certain technologies appear to assist us to fulfill these requirements in a cost effective manner, then let's continue to employ and experiment further with these learning aids.

In my experience there is good reason for universities to adopt a prudent approach in the development and utilisation of interactive multimedia courseware. For my purposes I have elected to invest in the development of flexible course resources - comprehensive and accessible information archives that are most efficiently and effectively managed in digital form. This leaves it to the creativity and inspiration of the teacher of the day as to how best to utilise these for maximising student learning. Thus, as our insights into the educational process in an information rich environment grow, we will be able to fashion our digital course resources into the most appropriate courseware design that fits within the unique myriad of constraints under which each of us, as teachers, are operating. One secret that is essential to success under this modus operandi is to ensure that such digital material is in an internationally recognised format which makes it upwardly compatible as commercial and public domain software evolves.

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Appendix

Discussion of design criteria in CAL we might address some or all of the following:

1. under what conditions is CAL a cost-effective methodology ?

2. what is the relevance, if any, of Wilson's suggestion that human attention rather than information is the more important currency in the future ?

3. what merit is there in the work of Montgomery-Woods et al., and the matrix in Table 1 ?

4. what do we understand about the nature of teacher/student/subject-matter relations, how these are changing, and how such changes impinge on the design and development of CAL ?

In particular:

4a) what value, if any, is there in proposing that students are the customers of universities ? (or even condoning this view when it is observed to be implicit in the actions of the bureaucrats who control much of the funding of universities ?) (and is this even relevant ?)

4b) what views of their role in the teaching-learning process are held by academics and how do these affect the choice of design criteria in CAL ?

4c) to what extent do university teachers subscribe to the constructionist theory of learning ? (and is this even relevant ?)

4d) should we be fostering skill development in our students in sifting data for information, and sifting information to help in the creation of personal knowledge ? Under what conditions can CAL help this process ?